Safe, High Energy Batteries for Space Suits, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

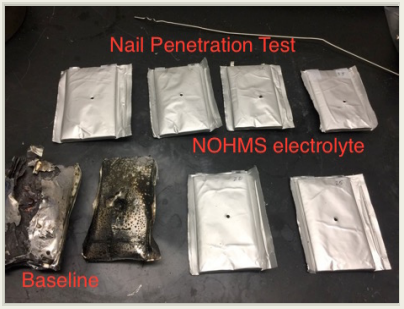
A new generation of spacesuits is needed to support EVAs for future surface exploration missions. These new suits will require decreased mass and volume, improved functionality, and excellent reliability. More power is required than today's suit can provide. The battery pack will be the main source of power and weight and needs to provide an energy source for life-support functions, communications, system health status, and other needs. In addition, the battery must operate safely under harsh conditions of extreme temperatures, mechanical injury, and tolerate radiation. NOHMs Technologies is proposing to develop ionic liquid based hybrid electrolytes for safe, high energy density, high voltage, and high power batteries for space suit applications.

NOHMs will develop a safe electrolyte for $LiCoO_2$ that prevents thermal runaway and allows $LiCoO_2$ to be charged at a higher voltage resulting in higher capacity. Rechargeable lithium ion batteries (Li-ion) are promising energy storage options for space applications. When charged to 4.2V $LiCoO_2$ delivers 140 mAh/g specific capacity, which is only 51% of the theoretically possible (272 mAh/g) based on the crystal structure and allowable Li-ions it can host. To extract the unutilized capacity from the $LiCoO_2$, one has to electrochemically activate the cathode by charging to a potential > 4.5 V *vs* Li/Li^+. It has been shown that the high voltage charging of $LiCoO_2$ results in 28% increase in delivered capacity and 4% increase in the nominal voltage. However, conventional Li-ion battery electrolytes are not stable at such high voltages and complementary development of electrolytes that are stable at these voltages are needed. In this Phase I, we will design electrolytes with functional ionic liquids and co-solvents to enable a high voltage, thermally stable and electrolyte formulation for traditional $LiCoO_2$ cathode materials.

Anticipated Benefits

Initial NASA space-based applications include space suit power and EVA applications which will be supported by a space suit manufacturer. Additional NASA applications are satellites, Unmanned Aerial Systems, and other electric flight programs.

Non-NASA commercial applications will include UAS platforms, satellites, and submarines. As battery lifetimes are increased to exceed current Li-ion technology, then larger commercial applications such as electric vehicles and renewable energy storage systems will be addressable with this technology. In particular, the increased safety of the electrolyte technology will be attractive to the commercial aviation industry.



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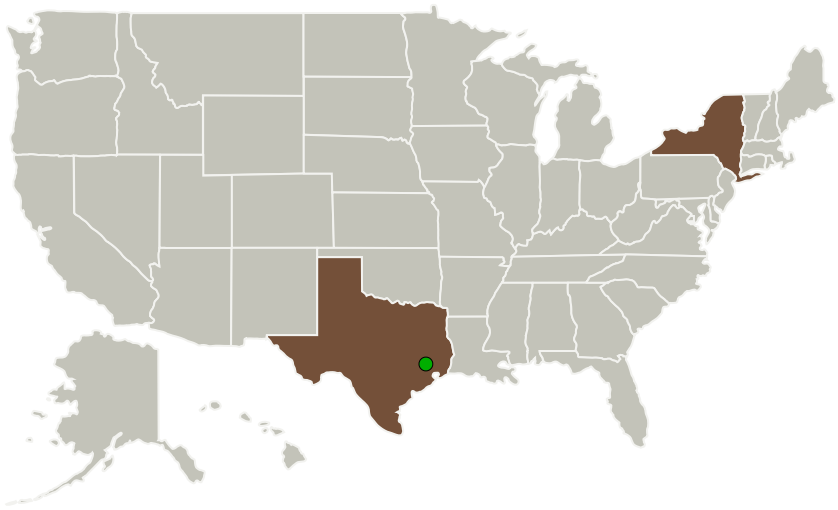
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Nohms Technologies	Lead Organization	Industry	Rochester, New York
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
New York	Texas

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141281)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Nohms Technologies

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

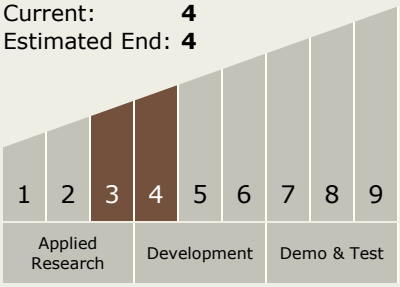
Carlos Torrez

Principal Investigator:

Surya Moganty

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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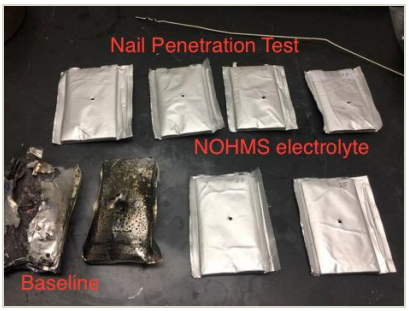
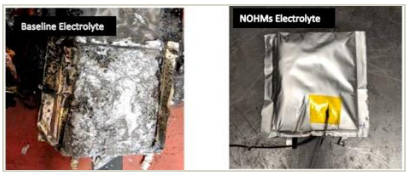
Images



Briefing Chart Image
Safe, High Energy Batteries for Space Suits, Phase I
(https://techport.nasa.gov/image/131467)



Final Summary Chart Image
Safe, High Energy Batteries for Space Suits, Phase I
(https://techport.nasa.gov/image/127568)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.2 Extravehicular Activity Systems
    - TX06.2.1 Pressure Garment

Target Destinations

Earth, The Moon, Mars